
NAVFAC IGS-03450 (APRIL 2003)

Preparing Activity: LANTNAVFACENGCOM Based on UFGS-03450

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

SECTION 03450

PLANT-PRECAST ARCHITECTURAL CONCRETE
04/03

NOTE: This guide specification is issued by the
Atlantic Division, Naval Facilities Engineering
Command for regional use in Italy.

NOTE: This guide specification includes the
requirements for solid-section precast concrete wall
panels with normal-weight aggregate portland cement
concrete, conventional reinforcing, and smooth
surface or exposed aggregate facing. The panels
specified are intended for attachment of the
building framing system at each floor elevation and
at the roof elevation. The panels may be provided
with built-in anchorage devices for the attachment
of thermal insulation blankets to the interior face
of the wall panels and for the attachment of metal
flashing after the wall panels have been installed.

Comments and suggestion on this specification are
welcome and should be directed to the technical
proponent of the specification. A listing of the
technical proponents, including their organization
designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer
choices or locations where text must be supplied by
the designer.

Note: Drawings should include a complete design
indicating the character of the work to be performed
and the following:

1. Location and details of wall panels, showing all

dimensions, and size and type of reinforcement.

2. Details of joints between wall panel units, showing sealant or gasket shape, dimensions, and location.

3. Details showing both the location and type of anchorage devices of the panels to the building framing system and the connection of other materials (reglets, insulation nailers, etc.) to the panels. Indicate gravity loads, live loads, dynamic loads, and stresses inherent in the structure for the manufacturer to provide embedded panel anchorage.

4. Locations where flashing reglets are required.

5. Locations of inserts (wedge type, slotted type, etc.) cast into the concrete panels.

6. Location of each type of surface finish, with details of transitions between different types of surface finishes.

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ITALIAN LAWS AND NORMS (D.M.)(LAW)(CIRC.)

NOTE: Italian laws and normatives are the legislative regulations and decrees issued by the Italian government in the form of laws, norms, decrees, circulars, and letters. These Laws and Decrees concur together with Norms and Standards in forming the governing directives for construction.

Law 595	(26 May 1965) Technical characteristics for hydraulic binders
Law 1086	(5 November 1971; Rev. 1983) Technical norms for the calculations, executions and testing of norms and prestressed reinforced concrete structures and metal structures
D.M. 9/1/96	(9 January 1996) Technical norms for the

calculation, execution and testing of
reinforced concrete, normal, prestressed
and for metal structures

D.M. 16/1/96

Technical norms relative to general
criteria for building safety verification
and for loads and superimposed loads

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

**NOTE: A UNI Norm is a technical normative
recognized as Italian Law, submitted by a private
organization "Ente Nazionale Italiano di
Unificazione" for Italy and is available only in
the Italian language. It is the National Standard.**

UNI 1751	(1988) Single coil spring washer - Normal series - Dimensions and mechanical properties
UNI 3159	(1983) Stainless, heat resisting steel and alloy sand castings - Qualities, requirements and tests
UNI 6127	(1998) Concrete specimens for strength tests - Making and curing
UNI 6132	(1972) Destructive tests of concretes - Compression test
UNI 7121	(1972) Normal mortar - Determination of air content
UNI 8520-1	(1999) Aggregates for use in concretes - Definition, classification and properties
UNI 8520-2	(1997) Aggregates for use in concretes - Requirements
UNI 8926	(1986) Steel wires to be used in manufacturing of electrically welded fabrics and lattice girders for the reinforcement of concrete
UNI 8927	(1986) Electrically welded steel fabrics and lattice girders for the reinforcement of concrete
UNI 8981-7	(1989) Durability of concrete works - Criteria for mix design, mixing and placing of concrete

UNI 10622	(1997) Zinc-coated (galvanized) steel bars and wire rods for concrete reinforcement
UNI 10765	(1999) Admixtures for concrete - Multifunctional admixtures for concrete - Definitions, requirements and conformity criteria
UNI 11001	(1962) Code of practice for edge preparation in fusion welding of steel structures

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN)
(UNI EN ISO)(UNI ISO)

NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.

UNI EN 196-7	(1991) Methods of testing cement - Methods of taking and preparing samples of cement
UNI EN 197-1	(2001) Cement - Part 1: Composition, specifications and conformity criteria for common cements
UNI EN 197-2	(2001) Cement - Part 2: Conformity evaluation
UNI EN 206-1	(2001) Concrete - Part 1: Specification, performance, production and conformity
UNI EN 212	(1988) Wood preservatives. Guide to sampling and preparation of wood preservatives and treated timber for analysis
UNI EN 450	(1995) Fly ash for concrete - Definitions, requirements and quality control
UNI EN 451-1	(1996) Method of testing fly ash - Determination of free calcium oxide content
UNI EN 480-2	(1998) Admixtures for concrete, mortar and grout - Test methods - Part 2: Determination of setting time
UNI EN ISO 898-1	(2001) Mechanical properties of fasteners

	made of carbon steel and alloy steel - Part 1: Bolts, screws and studs
UNI EN ISO 898-6	(1996) Mechanical properties of fasteners - Part 6: Nuts with specified proof load values - Fine pitch thread
UNI EN 934-2	(2002) Admixtures for concrete, mortar and grout - Part 2: Concrete admixtures - Definitions and requirements
UNI EN 1172	(1998) Copper and copper alloys - Sheet and strip for building purposes
UNI ENV 1250-1	(1996) Wood preservatives - Methods for measuring losses of active ingredients and other preservative ingredients from treated timber - Part 1: Laboratory method for obtaining samples for analysis to measure losses by evaporation to air
UNI EN ISO 1461	(1999) Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
UNI EN 1559-3	(1999) Founding - Technical conditions of delivery - Part 3: Additional requirements for iron castings
UNI EN 1744-1	(1999) Test for chemical properties of aggregates - Part 1: Chemical analysis
UNI ENV 1992-1-3	(1995) Eurocode 2: Design of concrete structures - Part 1-3: General rules - Precast concrete elements and structures
UNI ISO 4990	(1986) Steel castings - General technical delivery requirements
UNI EN 10020	(2001) Definition and classification of grades of steel
UNI EN 10025/A1	(1995/96) Hot rolled products of non-alloy structural steel - Technical delivery conditions
UNI ISO 10065	(1994) Steel bars for reinforcement of concrete - Bend and rebend test
UNI ENV 10080	(1997) Steel for the reinforcement of concrete - Weldable ribbed reinforcing steel B 500 - Technical delivery conditions for bars, coils and welded fabric

UNI EN 10147/A1	(1993/97) Continuously hot-dip zinc coated structural steels strip and sheet - Technical delivery conditions
UNI EN 12350-2	(2001) Testing fresh concrete - Part 2: Slump test
UNI EN 13369	(2001) Common rules for precast concrete products

1.2 SUBMITTALS

NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significantly to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Precast concrete wall panel; G

SD-03 Product Data

Cast-in embedded items and connectors; G

Connection devices; G

SD-04 Samples

Concrete wall panel surface finishing; G

SD-05 Design Data

Precast concrete wall panel design calculations; G

Contractor-furnished mix design; G

Concrete mix design for repair of surface defects; G

Precast concrete wall panel connection and embedment design calculations; G

SD-06 Test Reports

Strength tests; G

Submit commercial testing results in accordance with D.M. 9/1/96 and as required in paragraph entitled "Sampling and Testing."

SD-07 Certificates

Admixtures

SD-08 Manufacturer's Instructions

Installation of precast concrete wall panel

Cleaning of wall panel

Include precast concrete wall panel manufacturer's written recommendations for installation and cleaning.

SD-11 Closeout Submittals

Concrete batch ticket information

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver packaged materials, except for wall panels, to the project site in the original, unbroken packages or containers, each bearing a label clearly identifying manufacturer's name, brand name, weight or volume, and other pertinent information. Store packaged materials, and materials in containers, in a weathertight and dry place until ready for use.

1.4 PLANT INSPECTION

[At the option of the Contracting Officer, precast units may be inspected.] [Precast units shall be inspected by the QC representative prior to being transported to the job site.] The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.5 QUALITY ASSURANCE

1.5.1 Wall Panel Drawings

- a. Wall panel dimensions, cross-section, and edge details; location, size, and type of reinforcement, including reinforcement necessary for safe handling and erection of panels.
- b. Layout, dimensions, and identification of each panel, corresponding to installation sequence.
- c. Setting drawings, instructions, and directions for installation of concrete inserts.

- d. Location and details of anchorage devices and lifting devices embedded in panels, and connection details to building framing system.

1.5.2 Design Calculations

Submit design calculations prepared and sealed by a registered professional engineer demonstrating compliance with Law 1086, D.M. 9/1/96, and D.M. 16/1/96, including latest updates and revisions; and indicated loading conditions.

1.5.3 Connection and Embedment Design Calculations

Submit design calculations prepared and sealed by a professional engineer demonstrating compliance with the indicating connection and embedment details.

1.5.4 Mix Designs

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement[, fly ash, pozzolan, ground slag,] and admixtures; and applicable reference specifications.

1.5.5 Concrete Wall Panel Surface Finish Sample

Submit a concrete wall panel sample 300 mm by 300 mm by approximately 40 mm in thickness, to illustrate quality, color, and texture of both exposed-to-view surface finish and finish of panel surfaces that will be concealed by other construction. [Obtain approval prior to submission of sample panels.]

1.5.6 Required Records

UNI EN 206-1. Submit mandatory batch ticket information for each load of ready-mixed concrete.

PART 2 PRODUCTS

2.1 SOURCE MANUFACTURERS

2.1.1 Precast Fabrication Plants

The following precast concrete fabrication plants that generally comply with these specifications:

TOMMASI PREFABBRICATI - Apice S.r.l.
V. Fredda, 5
37066 Somma Campagna (VR)
Tel. 045/510699
Fax 045/510110
www.tommasi.com

EDILCEMENTO

V. Cinque Colli, 74
06024 Gubbio (PG)
Tel. 075/923091
Fax 075/923099
www.edilcemento.it

2.2 CONCRETE

2.2.1 Contractor-Furnished Mix Design

NOTE:

Law 1086, D.M. 9/1/96, and D.M. 16/1/96, including latest updates and revisions. Concrete shall have a 28-day compressive strength of 28 MPa. [Air content of plastic concrete shall be between 4 and 6 percent air by volume.] [Provide a dosage of air entraining agent as indicated in manufacture's instructions and in accordance with UNI EN 934-2. Check air content as specified in UNI 7121.] Use 25 to 35 percent (by weight) fly ash or pozzolan, 40 to 50 percent GGBF slag or a combination that is approved by the Contracting Officer.

[2.2.2 Exposed-to-View Facing Mixture

Provide aggregates for exposed-to-view facing mixture; white, gray, or buff portland cement or a blend of two or more portland cements; [air-entraining admixture;] and water. Provide exact proportions of facing mixture to produce concrete having the specified properties and capable of obtaining the approved surface color and finish.

]2.2.3 Backing Mixture

Provide the approved mix design.

2.3 MATERIALS

2.3.1 Fine Aggregates

NOTE: Choose appropriate gradation based upon use of concrete. Where concrete is for back-up and separate facing aggregate is used, a gradation or maximum aggregate size may be specified.

UNI 8520-1 and UNI 8520-2. Use only fine aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement. Fine aggregate shall be generally free from clay organic materials, water soluble alkali and substances which might cause expansion in the concrete in accordance with UNI EN 1744-1.

2.3.2 Coarse Aggregate

NOTE: Choose appropriate gradation based upon use of concrete. Where concrete is for back-up and separate facing aggregate is used, a gradation or maximum aggregate size may be specified for exposed architectural concrete.

NOTE: Italian concrete suppliers typically avoid the use of alkali-reactive aggregates. Do not allow use of such aggregates unless designer can verify local conditions and suppliers will allow and then will need to modify this specifications with appropriate tests and qualifications.

UNI 8520-1 and UNI 8520-2. Use only coarse aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement. Aggregate shall not contain slag, crushed concrete, clay organic materials, water soluble alkali or substances which might cause expansion in the concrete in accordance with UNI EN 1744-1.

2.3.3 Exposed Aggregate

NOTE: Choose appropriate gradation based upon use of concrete. Where concrete is for back-up and separate facing aggregate is used, a gradation or maximum aggregate size may be specified.

In addition to the above, facing mixture aggregate, and aggregate for homogeneous panels with exposed aggregate finish, shall be [gravel] [crushed gravel] [crushed stone] of size and color to produce exposed surfaces to match the color and texture of the sample on file with the Contracting Officer. Obtain aggregates for exposed aggregate finish from only one source.

2.3.4 Cementitious Material

"Cementitious Material" as used herein shall include all portland cement, fly ash, pozzolan and ground granulated blast-furnace slag.

2.3.4 Cement

Specify either a tricalcium aluminate content of 5 percent maximum or 50 percent ground iron blast furnace slag with 50 percent portland cement or 35 percent pozzolan with 65 percent portland cement when structure is within a saltwater spray range of 8 m or within a horizontal distance of 30 m.

NOTE: UNI EN 197-1 and UNI EN 197-2 cover 27 products in the family of common cements. They are grouped into five main cement types (refer to Table 1 of UNI EN 197-1).

The following are acceptable for use:

1. CEM I - Portland cement.
2. CEM II - Portland composite cement that includes the types:

CEM II/A-S, CEM II/B-S Portland-slag cement

CEM II/A-P, CEM II/B-P,
CEM II/A-Q, CEM II/B-Q Portland-pozzolan cement

CEM II/A-V, CEM II/B-V Portland-fly ash cement

The following are acceptable for use with restrictions on constituent materials or material percentages:

1. CEM II - Portland composite cement that includes the types:
CEM II/A-M, CEM II/B-M Portland-composite cement
2. CEM III - Blast furnace cement, type CEM III/A
3. CEM IV - Pozzolanic cement, type CEM IV/A
4. CEM V - Composite cement, type CEM V/A

The following are not acceptable for use:

1. CEM II - Portland composite cement that includes the types:
CEM II/A-D Portland-silica fume cement
CEM II/A-W, CEM II/B-W Portland-fly ash cement
CEM II/A-T, CEM II/B-T Portland-burnt shale cement
CEM II/A-L, CEM II/B-L,
CEM II/A-LL, CEM II/B-LL Portland-limestone cement

2. CEM III - Blast furnace cement, that includes the types:

CEM III/B, and CEM III/C

3. CEM IV - Pozzolanic cement, type CEM IV/B

4. CEM V - Composite cement, type CEM V/B

UNI EN 197-1 and UNI EN 197-2, blended cement except as modified herein. Blended and composite cements shall contain a minimum of 50 percent portland cement by weight of total cementitious materials.[Cement shall be high early strength cement, (Class R).] For exposed concrete, use one manufacturer for each type of cement[, pozzolan, fly ash, and ground slag].

2.3.5 Fly Ash and Pozzolan

NOTE: Fly ash and slag cement may produce uneven discoloration of the concrete during the early stages of construction, depending upon the type of curing provided. Fly ash or pozzolan meeting the specified test results, which are more stringent than ASTM C 618, should provide acceptable results, but it is recommended that fly ash, pozzolan, and ground slag not be permitted where appearance is an important factor. Fly ash or pozzolan should not be used in panels where light colored concrete is planned without first checking with the pigment manufacturer.

UNI EN 206-1 and UNI EN 450, Type (V) Siliceous fly ash, except that the maximum allowable loss on ignition shall be 6 percent and maximum available alkalis shall be 1.5 percent. The maximum allowable calcium oxide (CaO) content shall be 8 percent, as tested in accordance with UNI EN 451-1. Fly ash certificates shall include test results in accordance with UNI EN 206-1 and UNI EN 450 including Available Alkalies. Type (W) Calcareous fly ash shall not be used.

2.3.6 Ground Iron Blast-Furnace Slag

Law 595 and UNI EN 197-1.

2.3.7 Silica Fume

Silica fume shall not be used.

2.3.8 Burnt Shale

Burnt shale shall not be used.

2.3.9 Limestone

Limestone shall not be used.

2.3.7 Admixtures

UNI EN 480-2 and UNI EN 934-2 for air-entraining admixtures. Other admixtures: UNI 10765. [Certify that admixtures are free of chlorides.]

2.3.8 Water

Fresh, clean, and potable.

2.3.9 Reinforcement

**NOTE: Specify for zinc-coated (galvanized) bars.
Define where coated bars are to be used, if not for
entire project.**

All exposed steel shall be phosphate treated, primed, and coated to prevent rust.

2.3.9.1 Reinforcing Bars

[UNI ISO 10065 and UNI ENV 10080] [or] [UNI 10622].

2.3.9.2 Welded Wire Fabric

UNI 8927

2.3.9.3 Supports for Concrete Reinforcement

Include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening in place.

- a. Supports: UNI ENV 10080, wire-type reinforcing bars and welded wire fabric.
- b. Legs of supports in contact with formwork: Stainless steel, UNI 3159.

2.4 Cast-In Embedded Items and Connectors

Structural embedded anchorage and connections to panels shall be designed to withstand gravity loads, live loads, dynamic loads, any volume change stresses inherent in the structure, and loads indicated.

2.4.1 Inserts

2.4.1.1 Threaded-Type Concrete Inserts

UNI ISO 4990, cast steel. Provide [galvanized] ferrous casting having enlarged base with two nailing lugs minimum length less than the thickness of panel less 20 mm, and internally threaded to receive 20 mm diameter machine bolt. Ferrous castings shall be ferritic malleable iron. [Provide inserts hot-dip galvanized after fabrication in accordance with UNI EN 10147/A1.]

2.4.1.2 Wedge-Type Concrete Inserts

Provide galvanized, box-type ferrous castings with integral anchor loop at back of box to accept 20 mm diameter bolts having special wedge-shaped head. Provide ferrous castings of UNI EN 1559-3, ferritic malleable iron. [Provide inserts hot-dip galvanized after fabrication in accordance with UNI EN 10147/A1.]

2.4.1.3 Slotted-Type Concrete Inserts

Provide pressed steel plate, welded construction, box type with slot to receive 20 mm square head bolt, and provide lateral adjustment of bolt. Length of insert body, less anchorage lugs, shall be 110 mm minimum. Provide insert with knockout cover. Steel plate shall be 3 mm minimum thickness, conforming to UNI EN 10025/A1, steel grade S235. [Provide inserts hot-dip galvanized after fabrication in accordance with UNI EN 10147/A1.]

2.4.2 Embedded Plates

UNI EN 10020, [galvanized] ferrous metal plate connectors for attachment to the structural framing using manufacturer standard construction procedures. Headed studs shall use 400 MPa steel with construction conforming to UNI 11001. Deformed bar anchors shall conform to UNI 8926. [Provide embedded anchors galvanized after fabrication in accordance with UNI EN 10147/A1].

2.4.3 Embedded Attachments

2.4.3.1 Embedded Wood Nailer

Kiln-dried Standard Grade Douglas Fir or No. 2 Grade Southern Pine. Surface four sides. Treat with waterborne pressure-preservative in accordance with UNI ENV 1250-1 and UNI EN 212. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency.

2.4.3.2 Flashing Reglets

NOTE: When visible staining from the flashing reglet can occur, chromium-nickel stainless steel should be specified. When the wall panels will be subjected to a coastal salt atmosphere, steel flashing reglets should be used to prevent visible staining.

Fabricate of sheet metal, open-type with continuous groove 30 mm deep minimum by 5 mm wide at opening and sloped upward at 45 degrees. Top surface shall have toothed lip section to anchor upturned edge of metal snap-lock counter flashing when inserted. [Sheet metal shall be stainless steel, 0.28 mm minimum thickness, soft temper, UNI 3159.] [Sheet metal shall be copper strip for building construction, weight 4.8 kg per square meter minimum, UNI EN 1172, cold-rolled temper.] [Sheet metal shall be 0.5 mm minimum thickness, galvanized carbon steel sheet, UNI EN ISO 1461.]

2.4.4 Connection Devices

2.4.4.1 Clip Angles

UNI EN 10025/A1 steel, galvanized after fabrication in accordance with UNI EN 10147/A1.

2.4.4.2 Ferrous Casting Clamps

UNI EN 1559-3 malleable iron or cast steel, hot-dip galvanized in accordance with UNI EN 10147/A1.

2.4.4.3 Threaded Fasteners

Provide galvanized machine bolts, washers and, when required, nuts.

- a. Bolts: UNI EN ISO 898-1, 20 mm diameter machine bolts with hexagon head.
- b. Washers: UNI 1751, medium or heavy lock-spring washers.
- c. Nuts: UNI EN ISO 898-6, heavy, hexagon-type nuts.
- d. Square Nuts: UNI EN ISO 898-6, plain, square-type nuts where required for slotted-type concrete inserts.

2.4.5 Form Materials

Provide forms and form-facing materials of wood, metal, plastic, or other approved material to produce concrete having the specified finish. Construct forms mortar-tight and of sufficient strength to withstand all pressures due to concrete placing operations and temperature changes within the specified fabrication tolerances.

2.5 PANEL FABRICATION

UNI ENV 1992-1-3 and UNI EN 13369, unless specified otherwise.

2.5.1 Formwork and Fabrication Tolerances

Provide metal or wood forms. Brace and stiffen against deformation. Provide form liners where required to produce indicated finish. Provide dimensional tolerances as follows:

Overall panel dimensions:

3 m	Plus or minus 3 mm
3 to 6 m	Plus or minus 3 mm
6 m	Plus or minus 5 mm

Thickness: Plus 6 mm, minus 3 mm

Angular deviation of sides:

Plus or minus one percent, 2 mm

Deviation from square (difference in length of two diagonals):

Not to exceed 0.1 percent, 6 mm

Size and location of openings within one unit:

Plus or minus 6 mm

Local smoothness (deviation from a true plane):

Plus or minus 0.2 percent

Bowing (convex or concave):

Length of bow/480 (0.2 percent), with a maximum of 15 mm

Position of reinforcement: Within 6 mm of indicated position

Position of anchorage devices: Plus or minus 12 mm

Position of pick-up devices: Plus or minus 75 mm

2.5.2 Reinforcement

Law 1086, D.M. 9/1/96, D.M. 16/1/96, and UNI ENV 10080 including latest updates and revisions for placement and splicing; secure in position with tie wires, bar supports, and spacers.

2.5.3 Preparation for Placing Concrete

Remove hardened concrete, excess form parting compound, standing water, ice, snow, or other deleterious substances from form interiors and reinforcement before concrete placement. Secure reinforcement and embedded items.

2.5.4 Concrete Mixing and Conveying

2.5.4.1 Batch Plant, Mixer, Mixing, and Measuring of Materials

UNI EN 206-1.

2.5.4.2 Conveying

Prevent segregation and loss of materials.

2.5.5 Concrete Placing

NOTE: D.M. 16/1/96 supplements Law 1086; D.M. 16/1/96, para. 6.1.1 states that concrete must not be placed with temperature less than 0 deg. C, unless proper precautions are taken to ensure proper cold weather curing. UNI 8981-7 technical norm states that concrete must be manufactured and cast-in-place at temperature not lower than 10 deg. C, unless proper precautions are taken to ensure proper cold weather curing. No references address hot weather placing. Designer shall include additional requirements as may be necessary for a particular project location.

UNI 8981-7, Law 1086, and D.M. 16/1/96. Deposit concrete in the forms continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the precast concrete wall panel. Place concrete at a constant temperature of between 10 and 32 degrees C throughout fabrication of each panel. Make temperature of forms or molds the same as or close to the concrete temperature. Vibrate and consolidate concrete to prevent segregation and to produce a high-density concrete free of honeycomb and rock pockets. Exposed-to-view facing mixture shall be a minimum thickness of 20 mm unless indicated otherwise. Place backing mixture before facing mixture attains initial set.

2.5.6 Identification Markings

Permanently mark each panel to indicate pick-up points, location, orientation in the building, and date of casting. Identification markings shall correlate with approved detail drawings. Do not locate in exposed-to-view finished surfaces.

2.5.7 Finishing

2.5.7.1 Unformed Concealed Surfaces (Smooth Finish)

Provide a trowel finish. Level surface with a straightedge, and strike off. After surface water has disappeared, float and trowel surface. Provide smooth finished surface, free of trowel marks, and uniform in texture and appearance.

2.5.7.2 Smooth, Exposed-to-View Surfaces

Provide a smooth finish to all exposed-to-view surfaces of panels, unless otherwise indicated. Provide a concrete surface having the texture imparted by a steel form or other approved smooth surfaces form-facing material.

2.5.7.3 Exposed Aggregate Finish

Provide for exposed-to-view surfaces of panels, including chamfers, edges,

recesses, and projections, unless otherwise indicated. Provide standard smooth finish with outer skin of mortar removed, before concrete has hardened, and exposing coarse aggregate. A chemical retarder may be used on exposed face to facilitate removal of mortar. Match finish of the approved surface finish sample. Expose aggregates as soon after concrete placing as practicable [by wire brushing, sand blasting, or bush hammering] [or] [by washing the concrete surface with a diluted solution of muriatic acid to thoroughly clean exposed aggregate. Rinse concrete surface with fresh, clean water to remove traces of acid.]

2.5.8 Curing

Provide moist or steam curing or curing compound. Do not remove panel from forms; prevent moisture loss and maintain 10 degrees C minimum for at least 24 hours after finishing. Maintain panels in a surface damp condition at 10 degrees C minimum until concrete has attained 75 percent minimum of the design compressive strength. [Do not use steam curing with wood forms or in connection with chemically retarded exposed aggregate surfaces].

2.5.9 Repair of Surface Defects

Cut out defective areas to solid concrete, with edges of cuts perpendicular to the surface of the concrete, and clean thoroughly. Dampen area to be patched and brush-coat with nonshrink grout or bonding agent. Patch the surface in accordance with procedures previously submitted by the Contractor and approved by the Contracting Officer. Where exposed to view, the patches, when dry, shall be indistinguishable from the surrounding surfaces.

2.5.9.1 Smooth, Concealed Surfaces

Acceptable defective area shall be limited to holes left by rods and other temporary inserts, and to honeycomb or rock pockets of 6 mm diameter maximum. Remove fins and other projections on the surfaces.

2.5.9.2 Exposed-to-View Surfaces

The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed-to-view surface area and shall be limited to holes of 6 mm diameter maximum.

PART 3 EXECUTION

3.1 INSTALLATION

Verify that all parts of the supporting structure are complete and ready to receive the panels and that site conditions are conducive to proper installation. Install precast concrete wall panels and accessories in accordance with approved detail drawings and descriptive data, and as specified below.

3.1.1 Building Framing System

Provide supporting members, including anchorage items attached to or

embedded in building structural elements, prior to placement of panels.

3.1.2 Placing Panels

Panels shall attain the specified 28-day compressive design strength prior to placement. Provide temporary supports and bracing, as required, to maintain panel position and alignment during attachment to the building framing system. Secure adjustable connections after panels have been properly positioned. All welded connections shall conform to the requirements of UNI 11001.

3.1.3 Erection Tolerances

Locate panels to accommodate adjacent products, proper joint width, and alignment with adjacent precast members. Noncumulative dimensional tolerances for erection of panels are as follows:

a. Face width of joint

Panel dimension normal to joint

3 m and under: Plus or minus 5 mm

3 m to 6 m: Plus 5 mm minus 6 mm

Each additional 3 m: Plus or minus 2 mm

b. Joint taper (panel edges not parallel): 0.2 percent or 2 mm total, whichever is larger, but not greater than 10 mm

c. Panel alignment

1) Jog in alignment of edge: 6 mm

2) Offset in face of panel (exterior face unless otherwise noted): 6 mm

d. Variation from theoretical position, any location: Plus or minus 6 mm

e. Deviation from plumb: 0.2 percent, 10 mm maximum

f. Maximum warpage after erection: One corner out of plane of other three, 0.5 percent of distance from nearer adjacent corner, or 3 mm

g. Differential bowing or camber of adjacent panels: 6 mm maximum

3.1.4 Joints

Joint widths between panels shall be as specified unless otherwise indicated. Provide joints with sealants in accordance with Section 07920, "Joint Sealants."

3.1.5 Protection

Protect exposed-to-view facing from staining and other damage. Do not allow laitance to penetrate, stain, or harden on exposed surfaces.

3.2 CLEANING

Clean exposed-to-view surfaces of panels thoroughly with detergent and water; use a brush to remove foreign matter. Remove stains that remain after washing in accordance with recommendations of the panel manufacturer. Surfaces shall be clean and uniform in color.

3.3 SAMPLING AND TESTING

3.3.1 Product Quality Control

Provide a product quality control system in accordance with D.M. 9/1/96 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

3.3.1.1 Aggregate Tests

UNI 8520-1, UNI 8520-2, and UNI EN 1744-1. Perform one test for each aggregate size, including determination of the specific gravity.

3.3.1.2 Strength Tests

UNI EN 196-7. Provide UNI 6132 and UNI 6127 compression tests. Perform UNI EN 12350-2 slump tests. Mold six cubes each day or for every 15 cubic meters of concrete placed, whichever is greater. Perform strength tests using two cubes at 7 days and two at 28 days. Cure four cubes in the same manner as the panels and place at the point where the poorest curing conditions are offered. Moist cure two cubes and test at 28 days.

3.3.1.3 Changes in Proportions

If, the compressive strength falls below that specified, adjust the mix proportions and water content and make necessary changes in the temperature, moisture, and curing procedures to secure the specified strength. Notify the Contracting Officer of all changes.

3.3.1.4 Strength Test Results

Evaluate compression test results at 28 days in accordance with UNI 6132 using a coefficient of variation of 20 percent. Evaluate the strength of concrete by averaging the test results (two specimens) of standard cubes tested at 28 days. Not more than 20 percent of the individual tests shall have an average compressive strength less than the specified ultimate compressive strength.

3.3.2 Rejection

Panels in place may be rejected for any one of the following product defects or installation deficiencies remaining after repairs and cleaning

have been accomplished. "Visible" means visible to a person with normal eyesight when viewed from a distance of 6 m in broad daylight.

- a. Nonconformance to specified tolerances.
- b. Air voids (bugholes or blowholes) larger than 10 mm diameter.
- c. Visible casting lines.
- d. Visible from joints.
- e. Visible irregularities.
- f. Visible stains on panel surfaces.
- g. Visible differences between panel and approved sample.
- h. Visible nonuniformity of textures or color.
- i. Visible areas of backup concrete bleeding through the facing concrete.
- j. Visible foreign material embedded in the face.
- k. Visible repairs.
- l. Visible reinforcement shadow lines.
- m. Visible cracks.

3.3.3 Field Quality Control

Perform field inspection of panel connections. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts and washers within 7 working days of the date of inspection. All defective connections or welds shall be removed and re-welded or repaired as required by the Contracting Officer.

3.3.3.1 Welded Connection Visual Inspection

UNI 11001, furnish the services of AWS-certified welding inspector for erection inspections. Welding inspector shall visually inspect all welds and identify all defective welds.

-- End of Section --